(12) UK Patent Application (19) GB (11) 2 096 949 A

(21) Application No 8209930
(22) Date of filing 2 Apr 1982
(30) Priority data
(31) 56/047299
(32) 3 Apr 1981
(33) Japan (JP)
(43) Application published
27 Oct 1982
(51) INT CL³
B60C 9/00
(52) Domestic classification
B7C 3B11 3B17 3B9 RD
(56) Documents cited
US 4120339
(58) Field of search
B7C

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(54) Pneumatic radial tire

(57) A heavy duty pneumatic tire (1) comprises a carcass (4) composed of one or more rubberized plies each containing cords arranged in radial planes, an inner liner rubber (6), a belt (8), and a rubber strip (11) having a modulus at 20% elongation higher than that of the inner liner rubber, as measured in the circumferential direction of the tire, arranged between the carcass and the inner liner rubber at each side of the tire within a region extending from the mid position (M—M) of the sidewall to the adjacent end (8a) of the belt. The strips (11) may be reinforced with textile fibres, have a modulus at 20% elongation of at least 10 kg/cm², and a thickness of 0.5—3 mm.

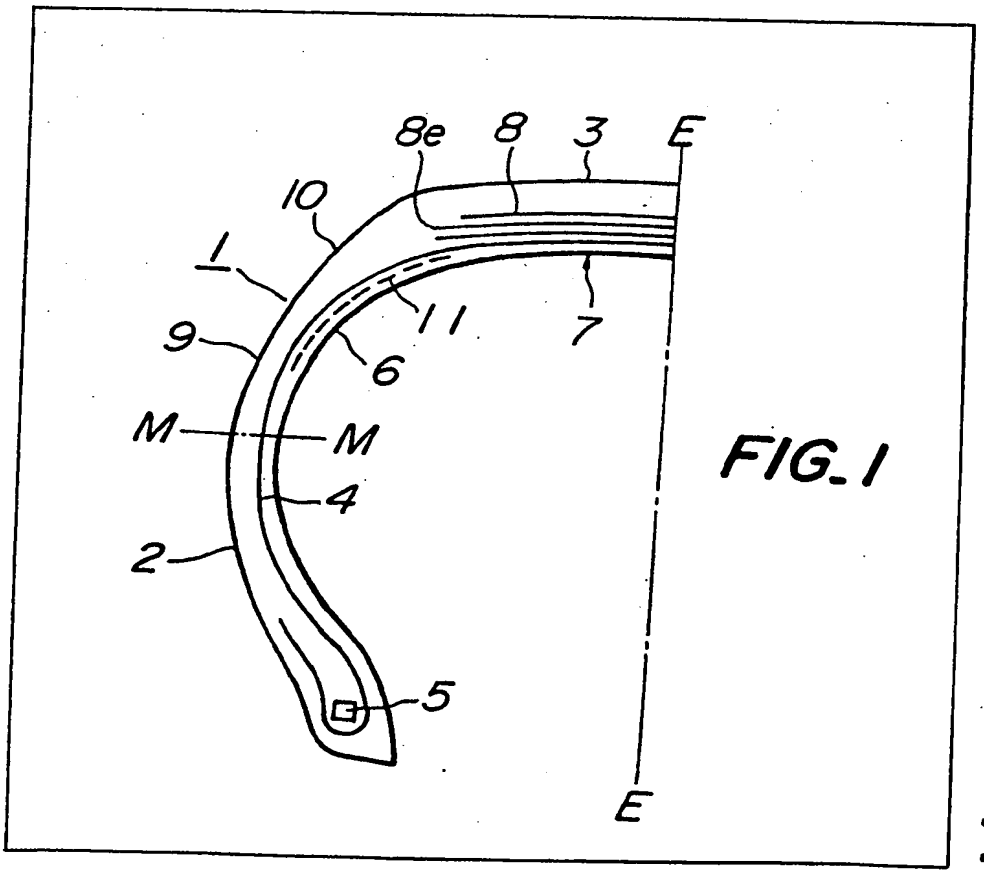

FIG. 1

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wherein a tire 1 comprises a sidewall 2, a tread 3, a toroidal carcass 4 and a bead core 5. In this case, the tread and both sidewalls are totally reinforced with the toroidal carcass extending between both the bead cores. In Figure 1, the right half section of the tire is omitted, but it is a matter of course that both sides of the tire are symmetrical about the equatorial line E—E.

In this embodiment, the carcass 4 is constructed by turning a single rubberized ply layer containing steel cords arranged in planes parallel to the radial plane containing the rotational axis of the tire, that is in a direction perpendicular to the equatorial line E—E, around the bead core 5 and lining the inner peripheral surface of the carcass with an inner liner rubber 6.

Between the carcass 4 and the tread 3 in the crown portion 7 of the tire is arranged a belt 8 composed of a plurality of rubberized ply layers each containing cords inclined at an angle of 10°—25° with respect to the equatorial plane E—E in a conventional manner, the cords of the belt ply layers being crossed with each other, up to the tread width. In the illustrated embodiment, the belt 8 is composed of three layers each containing steel cords. The tire has an outer reinforcing rubber 9.

In Figure 1, between the carcass 4 and the inner liner rubber 6 in an upper portion 10 of the sidewall extending from a line M—M dividing the sidewall into two in the radial direction of the tire to an end portion 8*e* of the belt 8 is arranged a rubber sheet 11, preferably reinforced with fibrous filaments 12 embedded therein.

Figure 2 shows in detail the rubber sheet 11 reinforced with the embedded fibrous filaments 12. In this case, the filaments 12 are preferably selected from nylon fibre, rayon fibre, polyester fibre, cotton filaments and wool filaments. The rubber sheet is formed by coating a layer of filaments 12 entangled with each other with rubber, or by cutting filaments into short lengths and kneading them into rubber with orientation or non-orientation of the filaments. The gauge of the rubber sheet 11 depends upon the applicable tire size, but is preferably 0.5—3 mm, more preferably 1—2 mm. The rubber sheet 11 is not necessarily arranged over the whole region extending from the line M—M to the end portion 8*e* of the belt 8, but can be arranged from the end portion 8*e* of the belt 8 towards the line M—M within the range of about 3/4, particularly 1/2, of the above region as shown in Figure 1. The modulus of the rubber sheet 11 must be higher than the modulus of the inner liner 6 as measured in the circumferential direction of the tire (or direction perpendicular to the plane of the drawing) in the arrangement shown in Figure 1 regardless of the reinforcement with the filaments, or otherwise the above-described deterioration of the inner liner rubber cannot be avoided. Since the inner liner rubber usually has a modulus at 20% elongation of about 6 kg/cm², the rubber sheet 11 preferably has a modulus at 20% elongation of 10 kg/cm² or more.

In the case of manufacturing the tire according to the invention, the inner liner, rubber sheet and carcass ply can be successively placed on a cylindrical drum in order at the first stage, so that even if the green case is toroidally deformed at the second stage, the rubber sheet does not prevent the opening between cords of the carcass ply, that is toroidal deformation in the unvulcanized state. After the vulcanization of the tire, the rubber sheet is strengthened and can effectively prevent the penetration of the inner liner rubber or tube between cords of the carcass induced by a high internal pressure when embedding the reinforcing filaments in the rubber sheet.

As described above, by means of the tire according to the invention, it is possible to simply and advantageously overcome weakening of carcass reinforcement in the region outside the edge of the belt, which occurs in the manufacture of heavy duty pneumatic radial tires.

CLAIMS

1. A pneumatic radial tire comprising a pair of bead cores, a pair of sidewalls, a tread extending between the sidewalls, a toroidal carcass composed of one or more rubberized ply layers each containing cords arranged in planes substantially parallel to a radial plane containing the rotational axis of the tire, an inner liner rubber at the inner peripheral surface of the carcass, and a belt superimposed about the crown portion of the carcass, wherein between the carcass and the inner liner rubber is arranged a rubber sheet extending within a region from substantially the middle position of the sidewall to the end portion of the belt, the rubber sheet having a modulus at 20% elongation which is higher than that of the inner liner rubber in the circumferential direction of the tire.

2. A tire as claimed in Claim 1, wherein the rubber sheet has a modulus at 20% elongation of at least 10 kg/cm².

3. A tire as claimed in Claim 1, wherein the rubber sheet is arranged within a range of about 3/4 of the region extending from the middle portion of the sidewall to the end portion of the belt.

4. A tire as claimed in any of Claims 1 to 3, wherein the rubber sheet is reinforced with fibrous filaments embedded therein.

5. A tire as claimed in Claim 4, wherein the fibrous filaments are selected from nylon fibre, rayon fibre, polyester fibre, cotton filaments and wool filaments.

6. A tire as claimed in any of Claims 1 to 5, wherein the rubber sheet has a gauge of 0.5 to 3 mm.

7. A tire as claimed in Claim 6, wherein the rubber sheet has a gauge of 1 to 2 mm.

8. A pneumatic radial tire according to Claim 1, substantially as herein described with reference to and as shown in, the accompanying drawings.

9. In a heavy duty pneumatic radial tire comprising a pair of bead cores, a pair of

sidewalls, a tread extending between both sidewalls, a toroidal carcass composed of one or few rubberized ply layers each containing cords arranged substantially in parallel to a radial plane including the rotary axis of the tire, an inner liner rubber covering the inner peripheral surface of the carcass, and a belt superimposed about a crown portion of the carcass, the improvement wherein between the carcass extending from substantially the middle position of the sidewall to the end portion of the belt, and the inner liner rubber is arranged a rubber sheet having a modulus at 20% elongation in one direction, which is at least higher than that of the inner liner rubber by aligning the direction having the above modulus value in parallel to the equatorial line of the tire.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1982. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained